Meade® 12" LX200SC f/2.2 Schmidt Camera

Advanced photographic instrumentation for professional-level research.

Designed in 1930 by Bernhard Schmidt, the Schmidt Camera was the forerunner of the modern Schmidt-Cassegrain telescope. Notwithstanding all of the advances in optical and electromechanical technology over the intervening years, however, the classical Schmidt Camera to this day accomplishes feats of astrophotography that are simply unattainable with any other telescopic lens, telescope, or electronic imager. No other photo-optical instrument permits such extremely wide-field photography at such fast photographic speed and with such an amazingly flat imaging area to the field edge. Unlike the Schmidt-Cassegrain telescope, however, the Schmidt Camera is strictly a photographic instrument and can not be used visually.

Although it utilizes the basic optical design concepts originally developed by Bernhard Schmidt, the Meade 12" LX200SC f/2.2 Schmidt Camera takes full advantage of advanced technologies that were unimagined more than seventy years ago: technologies that include modern superclear optical glass; ultra-high-transmission coatings; microprocessor-controlled automatic pointing to any specified sky position, and CCD autoguiding, among numerous other fields. The 12" LX200SC represents the latest in wide-field photographic imaging instrumentation.

Field Area: Combining a 16" primary mirror with a 12" Schmidt correcting plate positioned at the primary mirror's radius, the Meade 12" LX200SC presents an *unvignetted* photographic field 4.3° in diameter, actual field area on the film surface is 4.3° x 5.4°. Light fall-off even at the field corners is negligible.

Focal Surface: The camera's focal "plane," as in all classical Schmidt designs, is a mildly convex surface, a surface machined to within precise tolerances on CNC machining centers at the Meade Irvine factory. During the period of a photographic exposure, a mating film holder contours standard 2.25" (120-format) cut film to the correct radius on the focal surface; the film holder is held in place magnetically. Five film holders are supplied with each camera as standard equipment. Spacing between the focal surface and the surface of the primary mirror is maintained by means of Invar® metallic rods that fix this distance irrespective of ambient thermal changes.

Photographic Speed: The focal ratio of the camera system is fixed at f/2.2 to permit very fast exposures while at the same time allowing the camera to achieve a limiting stellar photographic magnitude of approximately 18.0.

Far more than simply an exquisite imaging system, the Meade 12" LX200SC includes a broad array of electro-mechanical features that greatly facilitate operation of the camera itself:

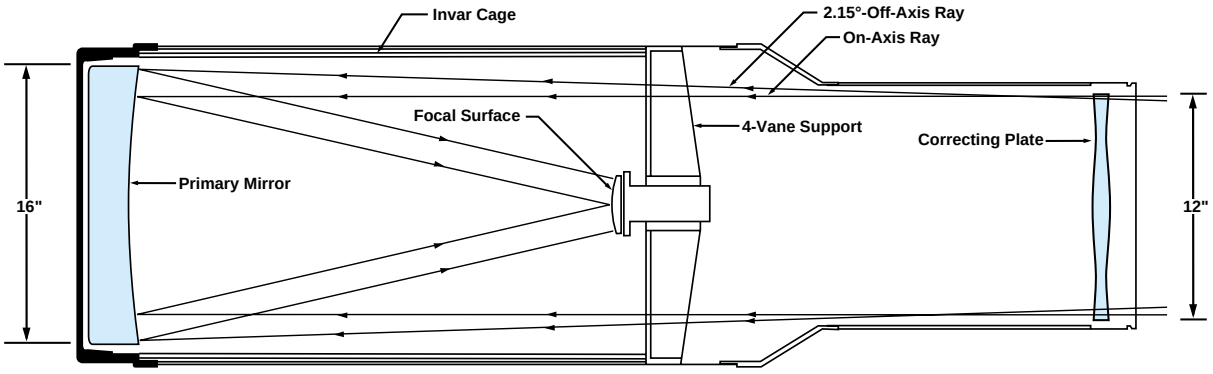
Equatorial Fork Mounting: Incorporating the oversize equatorial mounting of the Meade 16" LX200GPS Schmidt-Cassegrain *(pp. 48 - 57)*, the 12" LX200SC includes the same Autostar II technology as its sister instrument.

Automatic GO TO capability to any of 145,000 objects in the LX200GPS database (see p. 33 for a comprehensive listing), or to any RA and Dec. input to the Autostar II keypad, and with a typical pointing precision of better than 2 arc minutes.

High-Precision Pointing™ mode capable of pointing the camera, automatically, to a precision of better than one arcminute, if required.

165-speed drives on both axes, pushbutton-actuated through the Autostar II controller, from 0.01x sidereal photoguide rate to 6°/second fast-slew.

The Meade 12" LX200SC f/2.2 Schmidt Camera



The Meade 12" LX200SC, a Schmidt Camera of the classic design, uses a 2-sided aspheric correcting plate of 12" aperture. (Aspheric correction on the correcting plate in the drawing is exaggerated for clarity.) The correcting plate is positioned at the primary mirror's radius of curvature to correct fully for the spherical aberration induced by the spherical, and very "fast," f/1.67 primary mirror. The primary mirror is 16" diameter in order to achieve an imaged field at the focal surface that is fully illuminated over a large sky area—an area 4.3° in diameter in the case of the 12" LX200SC. The focal surface of the camera is *convex* (also exaggerated in the drawing), not planar as is the case with the great majority of astronomical imaging systems. A metallic cage of Invar® rods rigidly connects the cell of the primary mirror (with the Invar rods referencing against the front surface of the primary mirror) to the support vanes of the focal surface. Since focusing of the focal surface to the primary mirror is both extremely *sensitive* (a deviation of less than .001" results in star images that appear out of focus) and *permanent*, Invar (a material with virtually zero coefficient of thermal expansion) is used to assure that focus is not affected by changes in the environmental temperature.

Meade 12" LX200SC f/2.2 Schmidt Camera. Shown with standard-equipment 7" f/9 *ED* apochromatic refractor photo-guide telescope, Pictor 208XT autoguider/imager, and permanent equatorial pier.

Background photo: **Comet Hale-Bopp, March 15, 1997.** Photo by Steve Padilla with the Meade 12" f/2.2 Schmidt Camera at Mt. Wilson Observatory, Mt. Wilson, California. On the date of this photograph the comet was in the constellation Andromeda. Exposure: 5-mins. on Kodak Pro 400 PPF film.

Microprocessor-controlled sidereal-rate tracking (or one of 2000 other incrementally-variable solar, lunar, or planetary rates), with tracking periodic error at an observatory standard 5 arcseconds or less, using the dual-axis factory-programmed Smart Drive.

Permanent Equatorial Pier: The LX200SC must be permanently mounted in an observatory installation, using either the standard-equipment Meade permanent equatorial steel pier or a permanent pier of the user's design.

7" f/9 Photo-Guide Telescope: Piggybacked to the Schmidt Camera is a Meade 7" f/9 *ED* apochromatic refractor guide telescope *(p. 73),* itself an instrument of formidable photo-visual capabilities, for use with the Meade Pictor 208XT autoguider/imager *(below)* in precision, fully automatic guiding of the Schmidt Camera.

Pictor 208XT Autoguider/Imager: Placed in the eye-piece-holder of the 7" guide telescope, the 208XT autoguider/imager is capable of automatic guiding on stars as faint as 14th-magnitude.

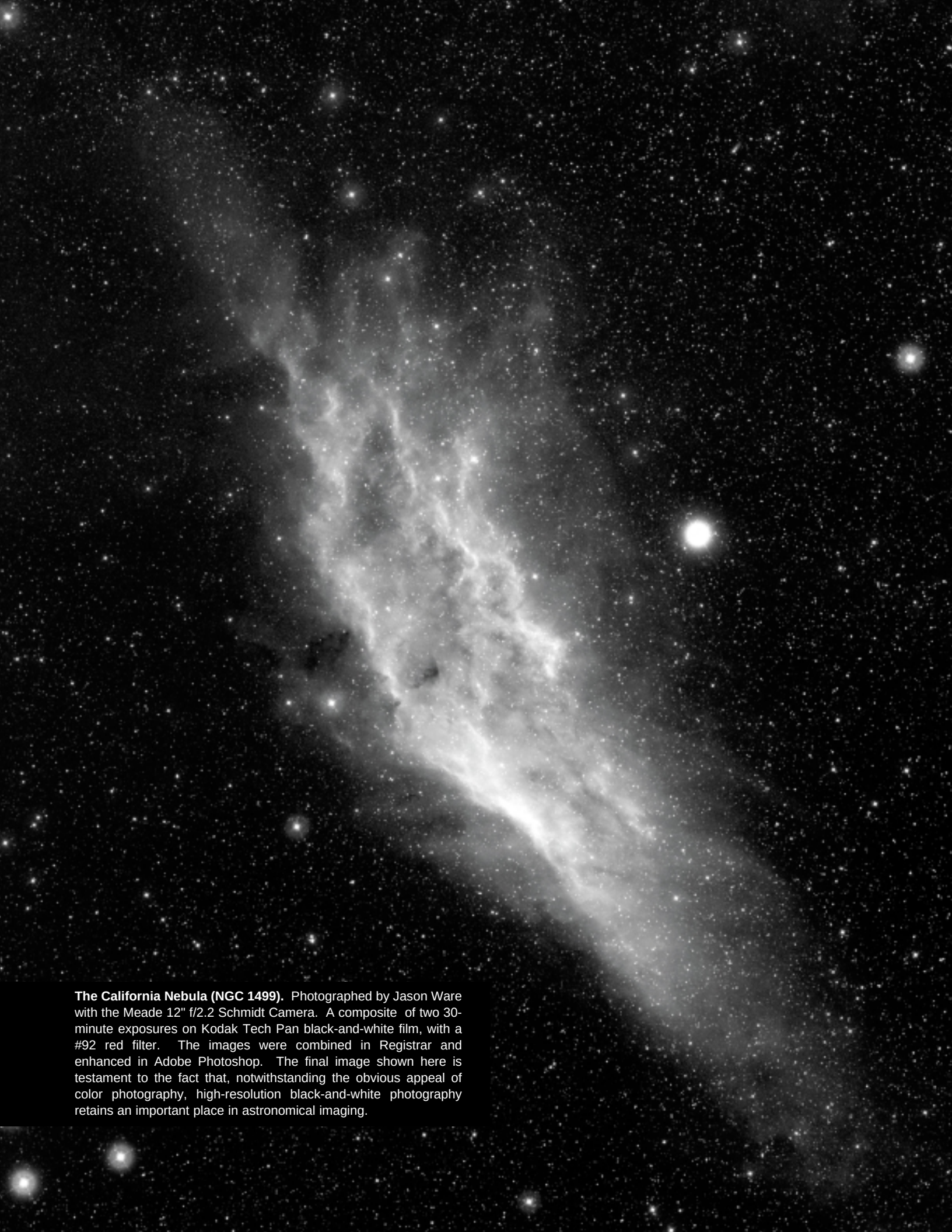
Using the Meade Schmidt Camera: As part of the LX200GPS system, the Meade 12" Schmidt Camera is straightforward and rewarding to use. Object location and centering, even of the faintest, most obscure galaxy, is as simple as entering the desired object on the Autostar II hand controller and pressing GO TO. In seconds the camera's massive equatorial mount automatically slews to the object, centering it precisely in the camera field. At the press of a button the Pictor 208XT CCD autoguider automatically locates, locks on to, and tracks a suitable guidestar through the 7" guide telescope, guiding the camera throughout the exposure at a *sub-arcsecond* level of precision. No guesswork or tedious, and potentially imprecise, manual guiding is required.

The 12" LX200SC's Pictor 208XT autoguider plugs into the CCD guider port on the control panel of the equatorial mounting. The camera can be automatically slewed to any input coordinates directly from the Autostar II hand controller.

Specifications and Features: 12" LX200SC

Optical Design	Classical Schmidt Camera
Correcting Plate Clear Aperture	305mm (12")
Primary Mirror: Diameter; Focal Length	406mm (16"); 680mm (26.8")
Photographic Speed	f/2.2
Optical Coatings	Ultra-High Transmission Coatings group *(p. 26)*
Limiting Photographic Magnitude *(approx.)*	18.0
Image Scale (degs./inch)	2.14
Film Area	2" x 2.5" (4.3° x 5.4°)
Unvignetted Field Diameter	4.3°
Film Requirement	2.25", 120-format, cut film
Optical Tube Dimensions (dia. x length)	17.5" x 58.5"
Film Holder Obstruction (dia.; %)	3.6"—9.0%
Equatorial Mounting	One-piece fork; double tine
Setting Circle Diameters	Dec.: 12"; RA: 17", with verniers
RA and Declination Control Systems	*both axes:* 165-speed, microprocessor-controlled 18v DC servo motor; 11" LX worm gear with Smart Drive software
Slew Speeds, RA and Dec.	0.01x to 1.0x sidereal, variable in 0.01x increments; 2x, 8x, 16x, 64x, 128x sidereal; 1°/sec. to 6°/sec., variable in 0.1° increments
Tracking Rates	sidereal, lunar, or custom-selected from 2000 incremental rates
Hemispheres of Operation	North and South, selected by GPS or user
Maximum Current Draw	2.0 amperes
Slow-Motion Controls	electric, RA and Dec.
Bearings	Dec.: 2 x 80mm roller bearings in Declination assembly of each fork arm; RA: 1 x 100mm and 1 x 150mm roller bearings
Autostar II Hand Controller	Atmel 89C451 & PIC16C57 microcontrollers; 2 line x 16 alphanumeric character display; 20-button keypad, red LED backlit
Main Telescope Controller	distributed intelligence architecture using 8 networked microcontrollers (Motorola 68HC11, Atmel 89C451, 3 x PIC16C62, 2 x PIC16C54, Sony digital signal processor); 3.5-Megabyte flash memory (field reprogrammable), 32K RAM
Onboard Celestial Object Database	147,541 objects
Materials: Tube Body and Mount Castings	aluminum
Correcting Plate	BK7 optical glass
Primary Mirror	Pyrex® glass
Permanent Equatorial Pier	Height: 42" (approx.); diameter: 10" material: steel; net pier weight: approx. 240 lbs.
Camera Dimensions, swung down	18" x 32" x 74"
Total Net Camera Weight (incl. Guide Telescope, Pier, and Tube Balance Weights)	585 lbs.
Total Shipping Weight	630 lbs.
Photo-Guide Telescope: Aperture	178mm (7")
Focal Ratio	f/9
Optical Design	*ED* apochromatic refractor
Viewfinder	8 x 50mm
CCD Autoguider	Meade Pictor 208XT
Limiting Autoguider Guidestar Mag.	14

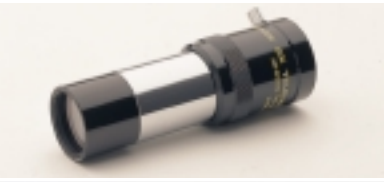
Specifications: 12" Model LX200SC f/2.2 Schmidt Camera—Includes 12" Schmidt Camera optical tube assembly with Ultra-High Transmission Coatings group *(p. 26)*; correcting plate clear aperture: 12" (305mm); primary mirror diameter: 16" (406mm); primary mirror focal length: 680mm; camera focal ratio: f/2.2; focal plane system for magnetic attachment of film holders accepting standard 2.25" (120-format) cut film; five film holders; tube balance weight system. Heavy-duty, one-piece fork mount with 6 roller bearings and dual-axis 11" worm gears; multi-function control panel display on the drive base; electric slow-motion controls on both axes; thermal stabilization fan; setting circles in RA and Dec.; Autostar II hand controller with digital readout display, factory-programmed Smart Drive, 165-speed drive control on both axes, GO TO controller, and onboard 145,000-object celestial software library; home-pulse software for remote telescope operation; 25 ft. power cord and adapter for telescope operation from 115v AC. Permanent observatory pier (specify observatory latitude within 0.5°). Meade 7" f/9 *ED* apochromatic refractor photo-guide telescope with brackets for piggyback attachment to the Schmidt Camera optical tube; 2" diagonal mirror with 1.25" eyepiece adapter; Series 4000 Super Plössl 26mm eyepiece; and 8 x 50mm viewfinder. Meade Pictor 208XT CCD autoguider/imager; operating instructions.



The California Nebula (NGC 1499). Photographed by Jason Ware with the Meade 12" f/2.2 Schmidt Camera. A composite of two 30-minute exposures on Kodak Tech Pan black-and-white film, with a #92 red filter. The images were combined in Registrar and enhanced in Adobe Photoshop. The final image shown here is testament to the fact that, notwithstanding the obvious appeal of color photography, high-resolution black-and-white photography retains an important place in astronomical imaging.

Accessories for Meade LX-Series Telescopes: 8" LX10; 8" LX90; 7", 8", 10", 12", 14", and 16" LX200GPS

See also pp. 94 - 107.



Series 4000 Eyepieces: Serious telescope users generally own about 4 to 6 eyepieces, for higher and lower magnifications, and for wide-angle observing as well. Meade Series 4000's are the finest eyepieces obtainable for astronomical telescopes and are available in 18 focal lengths and in 3 design formats to suit any observing requirement. Eyepieces of 2" barrel diameter require the #929 2" Diagonal Mirror *(facing page)*; the #929 is standard equipment on Meade 12", 14", and 16" LX200GPS models. *(See also p. 94.)*

Series 4000 8mm - 24mm Zoom Eyepiece: High-resolution, 7-element multi-coated optics with 55° field at 8mm. Graduated scale in 1mm units indicates exact focal length in use. An excellent complement to all Meade LX-Series telescope models. *(See also p. 96.)*

#140 Series 4000 2x Apochromatic Barlow Lens: Now widely copied, the Meade #140 2x Barlow was the first 3-element apochromatic (color-free) and air-spaced Barlow lens to be made commercially available. The #140 doubles each eyepiece power while maintaining uncompromised image resolution, color correction, and contrast. Multi-coated. 1.25" O.D. *(See also p. 96.)*

Series 4000 Photo-Visual Color Filters: Color filters significantly enhance visual and photographic image contrast of the Moon and planets. Each filter threads into the barrel of any Meade 1.25" eyepiece, and into the barrels of virtually all other eyepiece brands as well. Meade filters are available in 12 colors for lunar and planetary applications, and in Neutral Density as a lunar glare-reduction filter. *(See also p. 98.)*

Series 4000 Nebular Filters:
A modern boon to the city-dwelling deep-space observer, the interference nebular filter effectively cancels out the effects of most urban light pollution, while leaving the light of deep-space nebular emissions virtually unattenuated. *(See pp. 100 - 101 for full details.)*

#905 Variable Polarizer; #1A Skylight Filter: The #905 system includes 2 Polarizer filters mounted in a specially-machined cell, for glare-reduction in observing the Moon. Rotate the thumbscrew at the side of the unit to achieve light transmission between 5% and 25% of its original value. The #905 inserts into the diagonal prism of the telescope, followed by an eyepiece. The #1A Skylight Filter threads onto the rear cells of all Meade LX-Series telescopes and effectively seals the interior of the telescope from dust. All other rear cell accessories may then be threaded to the #1A filter. The filter increases visual and photographic contrast, decreases glare, and helps to penetrate haze.

#62 T-Adapter: The T-Adapter is the basic means of prime-focus photography through all Meade LX-Series models. Thread the T-Adapter on to the rear cell of the telescope, followed by a T-Mount for your 35mm camera, and the camera body is thereby rigidly coupled to the telescope.

#777 Off-Axis Guider: The #777 Off-Axis Guider provides a means, during long-exposure astrophotography, for the photographer to monitor the tracking of the telescope, to assure that the telescope remains precisely positioned on the object being photographed. Like the T-Adapter, the Guider couples the camera body to the telescope but it also causes a small amount of the guidestar's incoming light to be diverted at a right angle, where the star's position can be examined for tracking errors with an illuminated reticle eyepiece; position corrections can then be effected using the telescope's hand controller or drive corrector. *(See also p. 103.)*

Series 4000 f/6.3 Focal Reducer/ Field Flattener; Illuminated Reticle Eyepiece: Threaded on to the telescope's rear cell in front of the #62 T-Adapter or Off-Axis Guider, above, and the camera body, the f/6.3 Focal Reducer/Field Flattener ① reduces the main telescope's focal ratio by a factor of 0.63 (*e.g.,* from f/10 to f/6.3), thereby reducing photographic exposure times by about 50%. The Illuminated Reticle Eyepiece ②, with its crossline reticle pattern red-illuminated for easy night visibility, permits the observer to confirm the telescope's tracking accuracy during an extended exposure. *(See also pp. 104, 106.)*

Variable Tele-Extender: For eyepiece-projection photography of the Moon and planets through any Meade LX-Series telescope, a Tele-Extender is required. The Variable Tele-Extender threads onto the telescope's eyepiece-holder, into which is inserted an eyepiece of typically about 26mm focal length; the 35mm camera body couples to the Tele-Extender by means of a T-Mount. The Meade Variable Tele-Extender permits a range of projection magnifications. *(See also p. 103.)*

Field De-rotaters: Available for all Meade LX200 and LX200GPS models, Meade Field De-rotaters permit long-exposure photo or CCD imaging in the altazimuth mode. See pp. 24 and 49 for details.